Space Weather Technical Forecast

Issued on Sunday, 31 July 2022 at 00:23 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight Chance of G1/Minor Storm intervals day 1 (31Jul).

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity has been very low over the past 24 hours, with no significant flares. There are currently three sunspots on the visible disc, with a new and currently unnumbered sunspot emerging in the southwest quadrant. AR3068 is the largest region, with little change in the last 24 hours. The other two regions appear to be small and simple. A filament eruption observed lifting off in the far southeast quadrant produced a Coronal Mass Ejection (CME), although the bulk of the CME appears to be heading southwards, as seen in STEREO-A imagery. This may give a glancing blow to Earth towards the end of the period. Otherwise, no further Earth-directed CMEs (coronal mass ejections) were observed.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by DSCOVR at L1, remained slow-ambient in a range 320-370 km/s. Density was initially average, with a steady rise to above average from 30/0640UTC, peaking at 18ppcc just after 30/1200 UTC. The total interplanetary magnetic field (IMF), Bt, was mostly weak to moderate, peaking around 11 nT at 30/1902UTC, with the north-south component, Bz, fluctuating between +8nT to -7nT. The Phi angle was mostly negative (towards the Sun). Geomagnetic activity was Quiet (Kp 0-1).

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV), as measured by GOES-16 was at Background levels. The High energy electron flux (greater than 2MeV) varied between Background and Moderate levels, with a brief peak at high levels of 1070pfu observed at 30/1455 UTC. Electron fluence showed a slightly rising trend after 30/1200 UTC, remaining well below the Active threshold (1e8 integrated flux), with an observed fluence value of 2.62e7 integrated pfu recorded at 30/2100 UTC.

Four-Day Space Weather Forecast Summary

Solar Activity: Low or very low solar activity is expected to continue, with only a slight chance of M-class flares.

Solar Wind / Geomagnetic Activity: Solar winds initially starting at slow-ambient levels before the arrival of the fast wind of CH04 day 2 (31st). Solar winds then likely gradually easing day 2 and 3 (1st and 2nd), but could see further enhancement from the southern coronal hole (CH07/-) towards the end of the period on days 3 and 4 (2nd and 3rd Aug) and also from the possible arrival of the CME around the same time. Geomagnetic activity is forecast to be Quiet with a chance of Unsettled intervals, then Unsettled with Active intervals with a chance of G1/Minor storm with the arrival of the high speed stream (HSS) on day 1 (31st), and again later in the period on days 3 and 4 (2nd and 3rd Aug) from the arrival of the CME or from any enhanced solar winds related to the coronal hole in the southern hemisphere.

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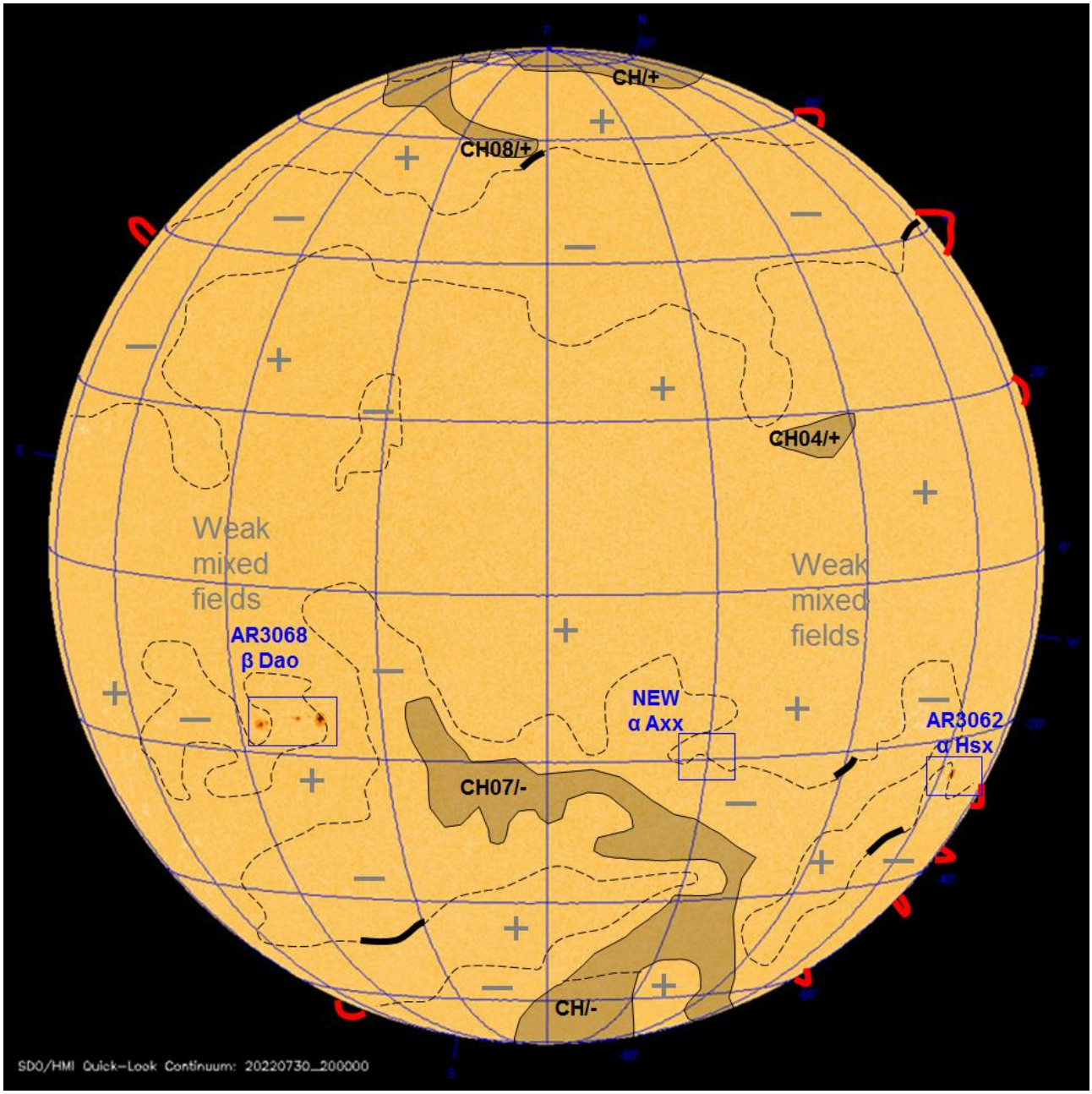
Met Office Space Weather Technical Forecast

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to remain at Background levels. The high energy electron flux (greater than 2 MeV) is expected to remain mostly at Background and Moderate levels, but with a chance of rising to give diurnal peaks of high. The corresponding 24 hour fluence is forecast to remain below the Active threshold (1e8 integrated pfu).

Figure 1. Solar Analysis Valid 2000UTC, 30 July 2022.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

Solar winds have remained at slow-ambient levels ahead of CH04/+ and the related HSS may reach Earth early on day 2 (31st Jul. The initial arrival would correspond to a weak enhancement observed at STEREO A around 28/1400 UTC, as this spacecraft observes solar wind conditions around 1.9 days ahead of Earth. There is some uncertainty however, as a further enhancement has been observed around 29/1800 UTC.

This uncertainty is compounded by the lack of useful persistence data, and Enlil appearing to have an erroneous strong and broad enhancement from day 1 (31st) whose source is uncertain. Some enhancement is possible later in the period from CH07/-, which is a northward extensions of the southern polar crown. However with Earth north of the solar equatorial plane, any such enhancement carries low confidence.
Quiet geomagnetic activity may become Unsettled with Active intervals and a chance of G1/Minor Storms with the arrival of any fast wind related to CH04 early on day 1 (31st Jul) but with a slight chance of Active to G1/Minor Storm intervals returning with any further enhancement from the CME impacting later in the period on days 3 and 4 (2nd and 3rd Aug) or from the HSS from CH07/- connecting with Earth.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	20	10	10	20
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
30/1243	Partial Halo	Filament Eruption	SE limb	406 km/s	*	Most CME material appears to have headed south

Figure 2: SOHO Lasco C2 imagery at 30/0400UTC showing CME from filament eruption.

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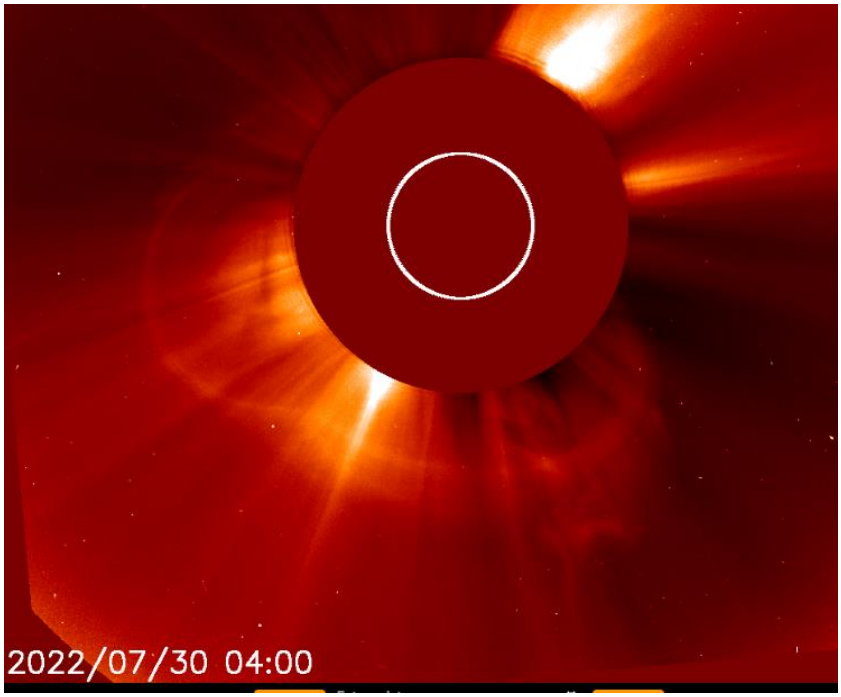

Radio Blackouts - X-Ray Flares:

Solar activity is currently very low, with no significant flares. There are currently three sunspot groups on the Earth-facing disc, one of which is currently unnumbered in the southwest. The largest and most active is AR3068 Dao/Beta in the southeast. This remains relatively small with little change observed in recent hours. The other two regions are both small and stable. Far-sided imagery suggest further active regions will rotate onto the Earth-facing disc through the period, with the next anticipated region being ex-AR3053, likely emerging from over the northeast limb on day 2 (1st Aug). Activity is expected to remain Low or Very Low, with only a slight chance of rising to Moderate from any M-flares, most likely from AR3068.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	5	5	10	10
Very Active	R3 to R5 X Class	No	1	1	1	1

Figure 3: X-ray flux plot at GEO with very little activity in the past 24 hours.

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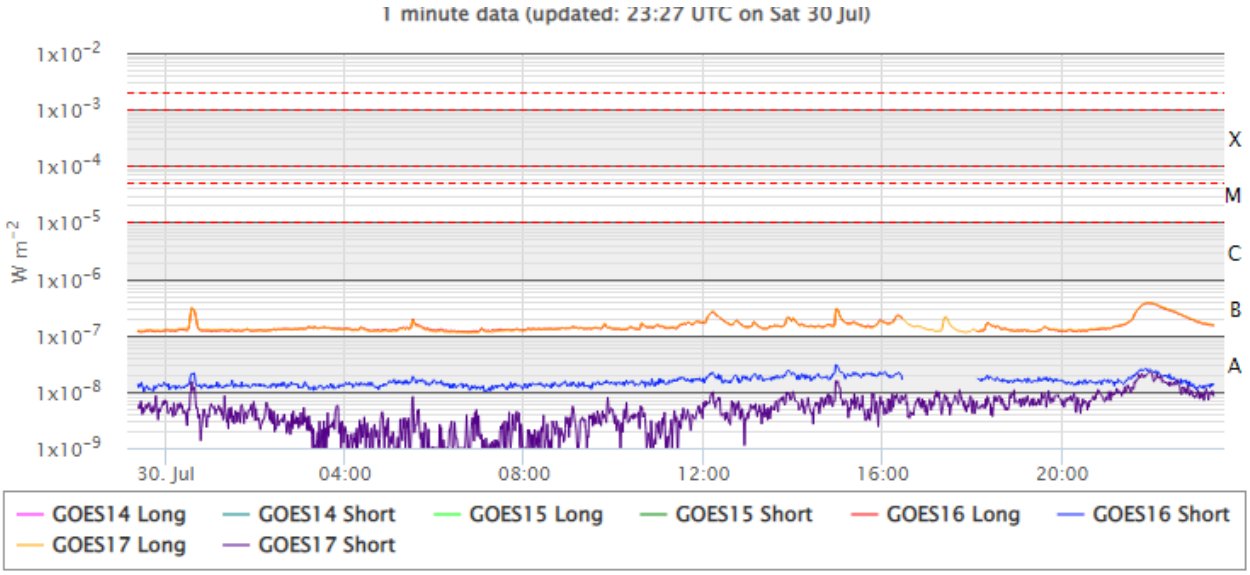


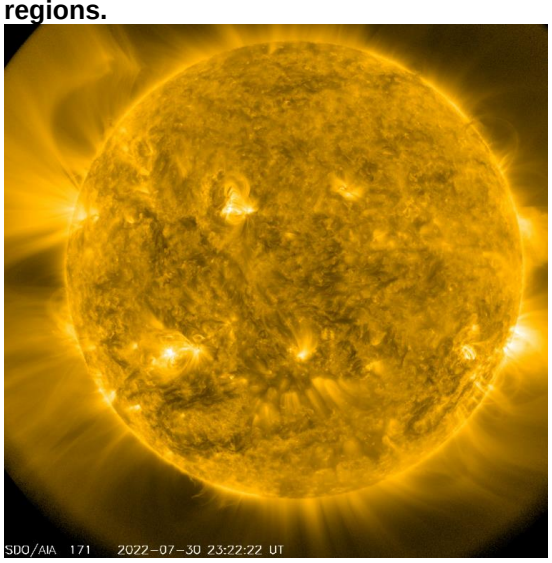
Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is currently at Background levels and is currently expected to remain at this level through the period.

Radiation Storms Probability (Exceedance)	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ S1**	No	1	1	1	1
Very Active	**≥ S3 ***	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

Figure 4: Latest SDO-aia 171 image showing position of current active regions and potential active regions.



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High Energy Electrons Event (≥ 2MeV):
The high energy electron flux (greater than 2MeV) as measured by GOES-16 is expected to continue fluctuating between background and moderate levels. This activity may rise in response to any enhancement, reaching High levels during diurnal peaks. The corresponding 24-hour fluence will most likely remain below the Active (1e8 integrated pfu) threshold through the period, with any enhancement unlikely to bring sufficiently persistent High flux to reach the Active level. This is supported by the Met Office REF model output.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	5	10	10
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 5: High energy electron flux at GEO and the Met Office REF model output.

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